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Macroeconomic risks, idiosyncratic risks and momentum profits

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Abstract

This paper investigates the presence of momentum return when priced for risk factors. Using a sample period from 1926 through 2005 for all stocks listed in the NYSE, AMEX and NASDAQ we show that significant momentum return remains both at the portfolio level and at the individual stock level. We report positive and significant alpha of 0.009 when Fama–French three factors and macroeconomic risk factors are used at the portfolio level. At the individual stock level, though Fama–French factors cannot eliminate momentum return, the premium diminishes when macroeconomic variables are used. The result is more pronounced when lagged variables are used and during market upturn.

JEL classifications: G11; G12; G19

Keywords: Momentum return; Fama–French factors; Macroeconomic risk factors; Portfolio level; Individual stock level

1. Introduction

We provide direct evidence that standard macroeconomic variables explain momentum returns. We use a test design that enables us to price securities using known risk factors representing both cross-sectional and time series variations. We are motivated by the early work of Chen, Roll, and Ross (1986) that introduce macroeconomic variables as common risk factors and Chordia and Shivakumar (2002) that uses them to predict stock returns which in turn explain momentum returns. We show that momentum cannot be explained by cross-sectional variations in stock returns. We provide evidence that macro-economic risk variables can explain momentum.

Momentum strategies of buying recent winners and selling recent losers earn a return of 12 percent per annum. Ever since this has been documented by Jegadeesh and Titman (1993) momentum remains one of the unsettled anomalies in finance literature. Perhaps one reason is the limited empirical work on direct evidence of risk based explanations. Profitability of momentum returns persist in different dimensions, over time, across markets and in different asset classes.[1] Behavioural explanations rest on *underreaction*, conservatism, individualism, self-attribution, and bounded rationality.[2] Risk based explanations use both cross-sectional and time varying risk factors including industry (Moskowitz & Grinblatt, 1999; Su, 2011) and illiquidity (Avramov, Cheng, & Hameed, 2013; Sadka, 2006), growth rate of industrial production (Liu & Zhang, 2008), credit risk of companies (Avramov, Chordia, Jostova, & Philipov, 2007; Lee, 2012), and predicted values of stock prices (Chordia & Shivakumar, 2002). The test procedures and the level of analysis employed in these studies are different.[3] We add to this

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[1] See Jegadeesh and Titman (1993, 2002), Rouwenhorst (1998), Muga and Santamaria (2007) Chan, Hameed, and Tong (2000), Chui, Titman and Wei (2010), Bacmann, Dubois, and Isakov (2001), Griffin, Ji, and Martin (2003), Moskowitz and Grinblatt (1999), Pang (2005), Okunev and White (2003).

[2] See Barberis, Shleifer, and Vishny (1998), Daniel, Hirsleifer, and Subrahmanyam (1998), Hong, Lim and Stein (2000), Chui, Titman, and Wei (2000), and Hong and Stein (2007).

[3] Details of the methodological differences in the earlier studies are given in the Literature Review section. However, most recent research performs their studies at the individual stock level.

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literature by providing direct evidence that standard macroeconomic variables can explain momentum returns.

The reason why lagged macroeconomic variables can explain the momentum returns could be due to time variation and investors' behavioural biases. If time variation in expected returns is the primary cause of momentum, then momentum should be nonexistent once priced for macroeconomic risk factors. We show that at the individual stock level alpha is not significantly different from zero once accounted for macroeconomic variables. Furthermore, in a macroeconomic environment of rapid real growth, high employment and low inflation, stock price increases. This increase in a stock price may provide a positive signal to the investors that these positive fundamentals will persist in future, making the investors overconfident. This motivates the investors to buy more shares and the increases in stocks returns attract more buyers resulting in a positive momentum. So during periods of market upturn momentum build up and continues and therefore allows the lagged macroeconomic variables to explain momentum returns. We report that our results are robust during market upturn.

We employ two sets of commonly used risk factors, e.g. Fama–French three factors for cross sectional variations and macroeconomic risk factors as in Chordia and Shivakumar (2002) for time series variations. Our economic question is what drives momentum. Therefore we start by estimating the risk premiums on individual stocks. We generate momentum portfolios conditioned on risk factors generating the risk premiums and idiosyncratic components that can not be attributed to them. Then we test directly if momentum returns from these portfolios are positive. Our analysis starts with raw returns at the portfolio level as most momentum studies (see among others, Griffin et al., 2003; Jegadeesh & Titman, 1993; Wang, 2003); however this study generates momentum profits in raw returns using two sets of risk factors encompassing both cross-sectional and time series variations.

We use first Fama–French three factors that represent cross sectional variations in stock returns. Next we use contemporaneous and lagged values of macroeconomic risk factors as in Chordia and Shivakumar (2002) that represent time series variations in stock returns. Momentum profits based on raw returns cannot be explained by any one of those risk factors. Our empirical findings confirm previous work and we document positive and significant alpha. We continue our analysis testing directly what derives momentum returns. For this purpose we estimate risk premiums on each stock one by one using the same risk factors. Both sets of risk factors Fama–French and Chen–Roll–Ross are in fact designed to price securities rather than portfolios. Once we estimate risk premiums on each stock we start constructing momentum portfolios. We construct momentum portfolios based on risk factors of stock returns and idiosyncratic components of stock returns separately. We show that at the portfolio level, alpha is positive and significant for both Fama–French three factors and macroeconomic factors when used as contemporaneous and as lagged variables. We report positive and significant alpha of 0.009 during the full sample period and in different sub-periods when Fama–French three factors are used both as contemporaneous and as lagged variables. We show that for contemporaneous macroeconomic variables during the full sample period alpha is 0.015 and 0.009 in different sub-periods. For lagged variables alpha is 0.009 in the entire sample period and on average 0.014 in different sub-periods, all of which are statistically significant. Our results are more pronounced during upmarket e.g. post-1950s and pre-2000s which also implies that the momentum return is closely linked to the business cycle.

At the individual stock level, when Fama–French factors are considered as risk factors, momentum return still remains. We report momentum returns generated when ranked based on idiosyncratic risk factors are, on average, more than 0.42 percent per month for both contemporaneous and lagged variables. Conversely, when macroeconomic variables are considered, though for the contemporaneous macroeconomic variables the returns generated based on the ranking of idiosyncratic risk factors is 0.159 percent per month as is statistically significant for the entire sample period from 1996 through 2005, for lagged variables momentum returns generated when ranked based on the idiosyncratic risk factors is negative of −0.155 percent per month, implying there is no momentum. The results are robust during market upturn which is consistent with the study of Chordia and Shivakumar (2002) that momentum returns are higher during market upturn. When combining both Fama–French factors and macroeconomic factors the result is mixed which could be due to the opposite effect of Fama–French three factors and macroeconomic factors in explaining momentum return. In sum, we conclude that though lagged macroeconomic variables can explain momentum return better; there is no evidence of absolute elimination of momentum returns once priced for risk factors.

The rest of the paper is organized as follows; section II presents a brief review of the literature, section III outlines the data and the methodology, section IV details the empirical findings and section V concludes.

2. Literature review

2.1. Momentum

Jegadeesh and Titman (1993) was the first to report that momentum strategy that buys past winners and sells past loser earns a significant excess returns. The effect of momentum is described basically as short- to-medium- term persistence in the stock returns. Though the bulk of empirical evidences have been found for the U.S. market, studies also find evidence of the momentum effect in other markets (among many others) e.g. European countries, United Kingdom, Germany, Spain, Latin America and Asia (See, Forner & Marhuenda, 2003; Glaser & Weber, 2003; Hameed & Kusnadi, 2002; Hon & Tonks, 2003; Muga & Santamaria, 2007, 2007a). The effect of momentum phenomenon has been studied over different asset class. To name only few, Okunev and White (2003) provide evidence of significant momentum return in foreign currency market. Miffre and Rallis (2007) confirm the presence of momentum in the commodity futures market. Avramov et al. (2007) show that momentum profitability is statistically significant and economically large among low-grade firms.

2.2. Momentum and risk factors

Empirical evidences of the continuous persistence of momentum return attract many researchers to identify and evaluate risk factors that can capture momentum effect. Risk-based studies argue that momentum return is due to the risk factors associated with stocks and can be largely attributed to compensation for bearing such risk. According to this explanation, expected excess returns on momentum strategies are attributable to common risk factors that are not accounted for and therefore, the momentum strategies can be justified in a rational asset pricing model (see among others, Ang, Chen, & Xing, 2006; Chordia & Shivakumar, 2002; Conrad & Kaul, 1998; Lewellen, 2002; Sagi & Seasholes, 2007). Among several risk factors the most that has been used in earlier momentum studies is the Fama and French three factors. There is controversy as to whether or not Fama–French three factors can explain momentum return. Several studies confirm that Fama–French three factors cannot capture the anomaly of momentum return (see among others Fama & French, 1996; Grundy & Martin, 2001). Again, studies document that when Fama–French three-factor are used in a conditional framework it explains momentum better at the individual stock level (see, among others, Wang, 2003; Wu, 2004).

One other risk factor that has been documented to capture momentum effect is the macroeconomic variables. Among these macro variables the most widely used are the four factors of Chen et al. (1986).[4] Griffin et al. (2003) examine the association between momentum return and macroeconomic variables at the portfolio level and show that when used as contemporaneous variables these risk factors cannot eliminate momentum return. These authors report that momentum profits around the world are economically large and statistically reliable in both good and bad economic states. Ferson and Harvey (1999) use these four macroeconomic variables as lagged variables and report strong evidence of the betas on the Fama–French factors to vary with the lagged macroeconomic variables.

Chordia and Shivakumar (2002) used the variables dividend yield (DIV), the short rate (YLD), the term premium (TERM) and the default premium (DEF) as macroeconomic variables and show that momentum return disappears when adjusted for their predictability on these lagged macro economic variables. In a subsequent study Avramov et al. (2007) confirms that momentum profits result from the predictability of macroeconomic factors. Antoniou, Lam, and Paudyal (2007) in their study show that two other variables e.g. business-cycle variables and behavioural biases can explain the profitability of momentum trading. Bhar and Malliaris (2011) study the changes in fundamental, macroeconomic, and behavioural variables across economic regimes and report that momentum is highly significant across all three regimes: low, average, and above average volatility.

Other risk factors include the industry factor Moskowitz and Grinblatt (1999) report that industry effects are the prime reason for momentum effect in the United States. However there is a debate on the capacity of the industry effect to explain momentum. Grundy and Martin (2001) conclude that industry momentum and individual stock momentum are distinct phenomenon. Su (2011) report that industry momentum remains profitable in the Chinese market even after controlling for lead–lag effect, January effect and individual stock momentum. Griffin et al. (2003) report that the economic state, in terms of the changes in the industrial production explains momentum. Cooper, Gutierrez, and Hameed (2004) find that momentum strategy depends on the up and down state of the market. These authors show that momentum disappears when accounted for the market state risk factors. In a subsequent study, Lee (2012) confirms the findings of Cooper et al. (2004). Wang, Huang, and Huang (2012) use a coincident economic indicator[5] as a proxy for market states in Taiwan market and report that coincident economic indicator is positively related to momentum return. These empirical evidences of the earlier studies thus give rise to the question as to whether or not momentum return still remains once priced for common risk factors. Furthermore it is worth investigating to see if momentum return disappears when the study is performed at the portfolio level and at the individual stock level.

3. Data and model

We collect returns of all stocks listed in the three exchanges including, NYSE, AMEX and NASDAQ on a monthly basis from the Centre for Research in Security Prices (CRSP) from January 1926 through December 2005. This results in a total number of 22,277 stocks over 960 months. We first conduct all empirical investigation on the entire sample period and then we analyze the results in each ten-year sub-period. The choice of ten-year sub-period is based on the consideration of sufficient observations so that meaningful parameter estimates can be obtained. This also allows mitigating survivorship bias and also examining how momentum return varies in different sub-periods.

We consider two sets of risk factors. Fama–French three factors that are used to explain cross sectional variation in stock returns and a set of frequently used macroeconomic variables as in Chordia and Shivakumar (2002) that are used to explain time series variation in stock returns. Fama–French

[4] Momentum literature widely utilized the macro economic variables of Chen et al. (1986). The variables that these authors develop are Industrial Production (MP), Unexpected Inflation (UI), Changes in expected inflation (DEI), Risk Premium (URP) and the Term Structure (UTS).

[5] In the study of Wang et al.. (2012) the components of the coincident economic indicator include industrial production; electric power consumption; real manufacturing sales; sales index of wholesale, retail, and food services; nonagricultural employment; real customs-cleared exports; and real machinery and electrical equipment imports.

three factors include return on CRSP value-weighted market index in excess of the one-month Treasury bill rate (MKT_RF), the small-minus-big size factor (SMB) and the high-minus-low book-to-market-ratio factor (HML) which has been collected from Kenneth French's data library[6] for the period from July 1926 through December 2005. This results in a total number of 955 months. The macroeconomic variables include dividend yield (DIV) which is the total dividend payment accrued to the CRSP value-weighted market index over the past 12 months divided by the current price level of the market index, the short rate (YLD) is the yield on the three-month Treasury bill, the term premium (TERM) is the yield spread of a ten-year Treasury bond over a three-month Treasury bill, the default premium (DEF) is the yield spread between Moody's Baa and Aaa rated bonds. Data on macroeconomic variables have been provided by Jeff Pontiff[7] and also comes from the Federal Reserve data in the Wharton Research Data Services (WRDS).

3.1. Measurement of momentum using raw returns

We use the conventional method of Jegadeesh and Titman (1993) to measure the raw momentum returns. At any time period t in the sample period, stocks are selected based on the past four quarters of the returns i.e. 3, 6, 9 and 12 months past return. Then the stocks are ranked based on these quarters, also known as the formation period and symbolized as J in the literature. These stock returns are then sorted in ascending order and ten equally weighted deciles portfolios are formed. The two extreme deciles portfolios i.e. the top decile portfolio (Decile1) contains the stocks with the lowest average J period returns, termed the loser portfolio whilst the bottom decile portfolio (Decile10) contains the stocks with the highest average J period returns, termed the winner portfolio.[8] We then take a long position in the winner portfolio and a short position in the equal size of the loser portfolio and hold the position over the following K month holding period. Momentum return is the difference between the return on the winner portfolio and loser portfolio at the end of the holding period. One month time period is skipped between the formation and holding periods.[9] We report results for the $JxK = 6x6$ strategy. For each month t, we rank all NYSE/AMEX/NASDAQ stocks on the monthly CRSP database into decile portfolios according to their compounded returns during the formation period. The Winner and Loser portfolios are equally-weighted portfolios of the ten percent of stocks with the lowest and highest returns over the formation period of the previous six months. The momentum strategy longs the winner portfolio and shorts the loser portfolio and holds the position during the six month holding period ($t + 1$ *through* $t + 6$). Since CRSP dataset include missing values (no trading) we consider all stocks that have non-missing values at the beginning of the holding period[10].

Once we calculate momentum returns we test if they can be explained by using risk factors that capture cross sectional and time series variations in stock returns. We use the following equation to test if alpha is different from zero.

$$MR_{t*,6x6} = \alpha + \sum_{j=1}^{n} \beta_j f_{t*} + \varepsilon_{t*} \tag{1}$$

$$MR_{t*,6x6} = \alpha + \sum_{j=1}^{n} \beta_j f_{t*-1} + \varepsilon_{t*}, \tag{2}$$

where, $MR_{t*,6x6}$[11] is the momentum return generated by using the conventional method of Jegadeesh and Titman (2001) with a $JxK = 6x6$ strategy, f_{t*} and f_{t*-1} are the risk factors as contemporaneous and as lagged variables, respectively, β_j ($j = 1,\ldots,n$) is the loading for factors and α and ε_{t*} are the constant and the residuals, respectively with $E(\varepsilon_{t*})=0$, $Cov(\varepsilon_{t*}, f_{t*})=0$ and $\varepsilon_{t*} \sim iid\ (0,\sigma^2)$.

3.2. Measurement of momentum using risk premiums and idiosyncratic components of returns

For each stock we decompose stock returns into two components; the risk premium calculated using the same risk factors as above and the idiosyncratic component that remains unexplained by those risk factors. For each stock we estimate the following regressions every month:

$$R_{it} = \alpha_i + \sum_{j=1}^{n} \beta_{ij} f_t + \varepsilon_{it}, \tag{3}$$

$$R_{it} = \alpha_i + \sum_{j=1}^{n} \beta_{ij} f_{t-1} + \varepsilon_{it} \tag{4}$$

where, R_{it} is the return of each stock i at time t, f_t and f_{t-1} are vector of risk factors as contemporaneous and as lagged, respectively, β_{ij} is the factor loadings α_i is the constant and ε_{it} is the residual. We decompose stock returns into two components. The risk premium component estimated $(\sum_{j=1}^{n} \widehat{\beta}_{ij} f_t)$ and idiosyncratic component estimated by $(\widehat{\alpha}_{it} + \widehat{\varepsilon}_{it})$. We construct momentum portfolios from these components. First we rank stocks based on their risk premiums $\sum_{j=1}^{n} \widehat{\beta}_{ij} f_t$ using past J months information and form deciles portfolios. The lowest portfolios (loser) are short and the highest portfolios (winner) are long and the positions are held for the subsequent K holding months. Hence at time $t*$ the momentum return is defined as

[6] The data is available at http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

[7] We thank Jeff Pontiff for providing the data.

[8] In literature these two extreme portfolios are termed as P1 and P10, respectively. Some literature also define those as the return on winner and return on loser or largely "winner" and "loser".

[9] This convention of skipping a month is widely utilized in recent literature so as to avoid bid-ask spread, price pressure, and lagged reaction effect. The time period may sometimes vary i.e. Jegadeesh and Titman (1993) skip a week.

[10] See also Hon and Tonks (2001).

[11] We define $t*$ as the time period when momentum return is realized following Jegadeesh and Titman (1993, 2001) with a strategy of $JxK = 6x6$.

$$MR^{Riskfac} = MR_{t*}^{\sum_{i=1}^{j}\widehat{\beta_{ij}f_j}} = R_{t*}^{WP^{\sum_{i=1}^{j}\widehat{\beta_{ij}f_j}}} - R_{t*}^{LP^{\sum_{i=1}^{j}\widehat{\beta_{ij}f_j}}} \quad (5)$$

where, $MR_{t*}^{Riskfac}$ is the difference between the winner and loser portfolio sorted based on the estimated common factors and $R_{t*}^{WP^{\sum_{i=1}^{j}\widehat{\beta_{ij}f_j}}}$ and $R_{t*}^{LP^{\sum_{i=1}^{j}\widehat{\beta_{ij}f_j}}}$ are the winner and loser portfolio respectively.

In a similar manner we generate momentum return by ranking stocks based on $\widehat{\alpha}_i + \widehat{\varepsilon}_{it}$ and at time $t*$ the momentum return is defined as and

$$MR_{t*}^{I} = MR_{t*}^{\alpha_i+\varepsilon_{it}} = R_{t*}^{WP^{\alpha_i+\varepsilon_{it}}} - R_{t*}^{LP^{\alpha_i+\varepsilon_{it}}} \quad (6)$$

where, MR_{t*}^{I} is the difference between the winner and loser portfolio sorted based on the estimated idiosyncratic (alpha and the residual) and $R_{t*}^{WP^{\alpha_i+\varepsilon_{it}}}$ and $R_{t*}^{LP_t^{\alpha_i+\varepsilon_{it}}}$ are the winner and loser portfolio respectively.

However, these alternative momentum strategies are formed by first estimating the parameters on individual stock where the parameters require using a sixty-month window and a minimum of twenty-four observations. Literature commonly uses a sixty-month window to calculate the parameter estimates to safeguard against potential problems of non-constancy of the estimates (β_i) in a large sample period. In our study we allow inclusion of stocks ranging from twenty-four to sixty observations the justification of which is that in the NYSE, AMEX and NASDAQ dataset exclusion of securities with less than sixty-observation will drastically reduce the number of observations.[12] Therefore for each month t, the above regression (Equation (1)) is run for all NYSE, AMEX and NASDAQ stocks with monthly returns on the CRSP database. We define momentum return thus generated as the 'Momentum return with Restricted Observations ($MR_{t*}^{Res}s$)'.

We make a summary of the three alternative momentum strategies as follows:

1. Momentum return using conventional method with restricted observation

$$MR_{t*}^{Res} = R_{t*}^{ResWP} - R_{t*}^{ResLP}$$

2. Momentum return generated from idiosyncratic risk (alpha and the residual)

$$MR_{t*}^{I} = MR_{t*}^{\alpha_i+\varepsilon_{it}} = R_{t*}^{WP^{\alpha_i+\varepsilon_{it}}} - R_{t*}^{LP^{\alpha_i+\varepsilon_{it}}}$$

3. Momentum return generated from risk factors

$$MR^{Riskfac} = MR_{t*}^{\sum_{i=1}^{j}\widehat{\beta_{ij}f_j}} = R_{t*}^{WP^{\sum_{i=1}^{j}\widehat{\beta_{ij}f_j}}} - R_{t*}^{LP^{\sum_{i=1}^{j}\widehat{\beta_{ij}f_j}}}$$

[12] Recent literature also employ the restriction of at least twenty-four observations see Chordia and Shivakumar (2002).

4. Empirical findings

To compare our findings with earlier studies we replicate momentum returns using the sub-period employed by two renowned researchers in the momentum literature, Chordia and Shivakumar (2002) and Jegadeesh and Titman (1993). Panel A of Table 1 reports momentum return generated when using $JxK = 6x6$ strategy with the sub-period in the study of Chordia and Shivakumar (2002). We confirm momentum return reported by these authors in different sub-periods. We document monthly momentum return of 0.23 percent for the whole sample period from 1926 to 1994, whereas Chordia and Shivakumar (2002) report a return of 0.27 percent per month for the same sample period. In particular, the most significant momentum return is generated in the period 1951–1963 of 0.88 percent while the lowest is reported in pre-1950s from 1926 through 1950 of −0.19 percent. Correspondingly, Chordia and Shivakumar (2002) document 0.83 percent return in the post-1950s while that comes down to −0.61 percent in pre-1950s. The trend of a declining momentum return during the last quarter of the millennium is also evident from the table. For example, an average of 0.67 percent return is generated during the period 1964–1994 while Chordia and Shivakumar (2002) find a return of 0.73 percent for the same period.

We also replicate different strategies of momentum return as examined by Jegadeesh and Titman (1993). Consistent with the findings of these authors we document that momentum returns are all positive and significant over the sample period from 1963 through 1989. Also as evident from Panel B of Table 1, in different combinations of J (formation period) and K (holding period) an average of 1 percent momentum return can be generated. Following Jegadeesh and Titman (1993) we also show that the strategy of $JxK = 3x3$ earns the lowest return. Whilst we report 0.65 percent momentum return, these authors report that to be 0.73 percent per month for the same strategy. However, we differ with Jegadeesh and Titman (1993) only in one case. The zero-cost strategy that worked best for us is the one with a strategy of $JxK = 9x3$, an average of 1.03 percent return is generated, while Jegadeesh and Titman (1993) document that the highest return of 1.49 percent is generated from the strategy with a formation period of twelve months and holding period of three months, ($JxK = 12x3$).

In sum, our results provide evidence of high momentum return for a period of fifty years from 1946 to 1995. Momentum return is comparatively low during the two end of the sample period e.g. pre-1950s and post 1995s. Particularly during the period of Chordia and Shivakumar (2002) momentum return is statistically and economically significant. The pattern of momentum phenomenon is quite allied with the business cycle. The return is high during periods when US stock market is rising and generates low returns when market is falling. These results are consistent with earlier studies that momentum return is linked to business cycle and market states (see Avramov and Chordia (2006) and Cooper et al. (2004)).

Table 1
Momentum returns: revisiting the sub-periods of Chordia and Shivakumar (2002) and Jegadeesh-Titman (1993). Following table reports the monthly momentum return using the sub-periods of two earlier studies, Chordia and Shivakumar (2002) and Jegadeesh and Titman (1993). Panel A shows the monthly momentum return using the four sub-sample periods in the study of Chordia and Shivakumar (2002). Following these authors with a momentum strategy of JxK = 6x6 momentum returns have been generated over various sub-sample periods. The column titled '% > 0' represents the percentage of the momentum returns that are greater than zero. Panel B reports the momentum returns following different JxK strategies over the sample period from January 1963 through December 1989 as in the study of Jegadeesh and Titman (1993). The *t* statistics are given in parenthesis. The estimates are reported in percentage.

Panel A: momentum return using the sub-period of Chordia and Shivakumar (2002)

Estimation this study					Chordia and Shivakumar (2002)				
Sub-period	Loser	Winner	Momentum	% > 0	Sub-period	Loser	Winner	Momentum	% > 0
1926–1994	1.400	1.630	0.230	62.560	1926–1994	1.340	1.610	0.270	63.260
	(8.637)	(8.637)	(8.637)			(3.390)	(6.060)	(1.100)	
1926–1950	1.970	1.780	−0.190	53.330	1926–1950	2.230	1.620	−0.610	56.800
	(5.428)	(5.565)	(-0.931)			(2.450)	(2.820)	(-1.12)	
1951–1963	0.660	1.540	0.880	81.290	1951–1963	0.700	1.530	0.830	65.330
	(3.382)	(8.604)	(12.188)			(1.690)	(4.430)	(3.280)	
1964–1994	0.980	1.650	0.670	64.960	1964–1994	0.900	1.630	0.730	67.460
	(4.835)	(9.081)	(6.484)			(1.970)	(4.800)	(2.510)	

Panel B: Momentum return using the sub-period of Jegadeesh and Titman (1993)

Estimation this study						Jegadeesh and Titman (1993)					
	K	3	6	9	12		K	3	6	9	12
J						J					
3	Loser	0.770	0.890	0.950	1.050	3	Loser	0.830	0.790	0.840	0.830
		(2.620)	(4.348)	(5.587)	(4.765)			(1.670)	(1.640)	(1.770)	(1.790)
	Winner	1.420	1.470	1.510	1.490		Winner	1.560	1.580	1.580	1.600
		(6.115)	(7.713)	(9.645)	(7.058)			(3.950)	(3.980)	(3.960)	(3.980)
	Momentum	0.650	0.580	0.570	0.450		Momentum	0.730	0.780	0.740	0.770
		(5.644)	(6.190)	(6.911)	(4.158)			(2.610)	(3.160)	(3.360)	(4.000)
6	Loser	0.750	0.820	0.900	1.040	6	Loser	0.660	0.680	0.670	0.760
		(2.538)	(3.902)	(5.256)	(7.326)			(1.280)	(1.350)	(1.380)	(1.580)
	Winner	1.600	1.650	1.610	1.510		Winner	1.790	1.780	1.750	1.660
		(6.145)	(8.450)	(10.022)	(10.861)			(4.470)	(4.410)	(4.320)	(4.130)
	Momentum	0.850	0.830	0.710	0.460		Momentum	1.140	1.100	1.080	0.900
		(5.392)	(7.795)	(7.956)	(6.180)			(3.370)	(3.610)	(4.010)	(3.540)
9	Loser	0.740	0.830	0.950	1.120	9	Loser	0.580	0.580	0.660	0.780
		(2.439)	(3.908)	(5.525)	(7.892)			(1.130)	(1.150)	(1.340)	(1.590)
	Winner	1.770	1.690	1.580	1.470		Winner	1.930	1.880	1.760	1.640
		(6.625)	(8.448)	(9.649)	(10.349)			(4.720)	(4.560)	(4.300)	(4.040)
	Momentum	1.030	0.860	0.620	0.340		Momentum	1.350	1.300	1.090	0.850
		(6.432)	(8.366)	(7.490)	(5.083)			(3.850)	(4.090)	(3.670)	(3.040)
12	Loser	0.770	0.910	1.050	1.230	12	Loser	0.480	0.580	0.700	0.850
		(2.521)	(4.192)	(6.114)	(8.679)			(0.930)	(1.150)	(1.400)	(1.710)
	Winner	1.740	1.590	1.490	1.390		Winner	1.960	1.790	1.670	1.540
		(6.413)	(7.911)	(9.014)	(9.731)			(4.730)	(4.360)	(4.090)	(3.790)
	Momentum	0.970	0.690	0.430	0.160		Momentum	1.490	1.210	0.960	0.690
		(6.036)	(6.964)	(5.657)	(2.788)			(4.280)	(3.650)	(3.090)	(2.310)

4.1. Portfolio level analysis

In this section we test if momentum return disappears after adjusting for risk factors through confirming the hypothesis of a zero alpha in a multiple-regression model at the portfolio level.

4.1.1. Does momentum return remain after adjusting for Fama–French three-factor at the portfolio level?

We regress momentum return on both Fama–French three factors and the macroeconomic factors and according to the null hypothesis we expect alpha not to be different from zero if momentum return is entirely explained by these risk factors, else otherwise. Since the distributions of both the Fama–French three factors and the macroeconomic variables are non-normal (not reported here to save space) and also as the residuals are heteroskedastic,[13] we derive the coefficient of the regression from White's heteroskedasticity consistent coefficient covariance. We start with the first set of risk factors e.g., Fama–French three factors and Panel A of Table 2 reports the average coefficients of the regression when the risk factors are the contemporaneous Fama–French factors on momentum return with a strategy of *JxK* = *6x6* and excluding penny stocks. We first regress momentum return on Fama–French three factors for the full sample period from 1926 through 2005 and then in each sub-periods. Column two through

[13] We perform heteroskedasticity test for both the Fama–French three factors and the macroeconomic factors.

Table 2
Portfolio Analysis: Momentum Strategy Returns Regressed on Fama–French Three-Factor Variables: Ten-year Sub-period Results. Winner, Loser and Momentum portfolios are formed based on the strategy described in Table 1 for the strategy excluding penny stocks with a strategy of JxK = 6x6. The following table represents the coefficients and the *t*-statistics obtained when momentum returns are regressed against the Fama–French three factor variables, e.g. MKT_ RF, SMB and HML. MKT_ RF is the monthly return on CRSP value-weighted market index in excess of the one-month Treasury bill rate, RF, SMB and HML are the Small-Minus-Big size factor and the High-Minus-Low book-to- market- ratio factor, respectively. The regressions are $MR_{t*,6x6} = \alpha + \sum_{j=1}^{n} \beta_j X_{t*} + \varepsilon_{t*}$ and $MR_{t*,6x6} = \alpha + \sum_{j=1}^{n} \beta_j X_{t*-1} + \varepsilon_{t*}$ where X is the vector of the Fama–French factors both as contemporaneous and as lagged variables. The regression is carried out separately for each sub-period. The coefficient covariance of the regression is derived from White's heteroskedasticity consistent coefficient covariance. Panel A shows the output for the Fama–French three factor variables when used as contemporaneous variables whilst Panel B reports the regression output when these variables are used as predictor variables over different sub-periods. The number in bold fonts represents significance at 5 percent level, *t*-statistics are reported in parenthesis and adjusted *R*-squared is also given.

Panel A: Fama–French three factor as contemporaneous variables

Period	Alpha	Mkt_Rf	SMB	HML	Adj R-squared
1926–2005	**0.009**	0.009	−0.029	−0.016	−0.001
	(11.654)	(0.507)	(−0.671)	(−0.440)	
1926–1935	0.007	0.006	0.038	0.013	−0.024
	(1.826)	(0.117)	(0.385)	(0.132)	
1936–1945	−0.001	0.018	−0.103	0.017	−0.013
	(−0.610)	(0.513)	(−1.116)	(0.215)	
1946–1955	**0.009**	−0.003	−0.055	0.012	−0.018
	(8.521)	(−0.091)	(−0.982)	(0.278)	
1956–1965	**0.011**	−0.014	−0.002	−0.059	−0.016
	(12.110)	(−0.498)	(−0.037)	(−1.071)	
1966–1975	**0.007**	−0.070	−0.040	0.071	0.021
	(3.826)	(−1.255)	(−0.330)	(0.776)	
1976–1985	**0.014**	0.035	−0.043	**−0.148**	0.065
	(8.819)	(1.030)	(−0.743)	(−2.500)	
1986–1995	**0.015**	−0.002	−0.037	**−0.130**	0.006
	(9.889)	(−0.057)	(−0.554)	(−2.073)	
1996–2005	**0.011**	−0.037	−0.103	−0.140	0.021
	(12.110)	(−0.498)	(−0.037)	(−1.071)	

Panel B: Fama–French three factor as lagged variables

Period	Alpha	Mkt_Rf_{t-1}	SMB_{t-1}	HML_{t-1}	Adj R-squared
1926–2005	**0.009**	−0.020	0.019	0.003	−0.001
	(11.914)	(−0.882)	(0.396)	(0.080)	
1926–1935	0.007	−0.035	0.122	0.041	0.004
	(1.799)	(−0.725)	(1.172)	(0.417)	
1936–1945	−0.002	−0.068	0.039	0.063	−0.005
	(−0.819)	(−1.215)	(0.454)	(0.774)	
1946–1955	**0.009**	0.009	−0.045	0.058	−0.001
	(8.647)	(0.319)	(−0.819)	(1.185)	
1956–1965	**0.011**	−0.038	−0.007	**−0.116**	0.019
	(12.108)	(−1.594)	(−0.112)	(−2.175)	
1966–1975	**0.007**	−0.080	−0.026	0.062	0.021
	(3.755)	(−1.457)	(−0.298)	(0.623)	
1976–1985	**0.014**	0.013	−0.036	**−0.136**	0.035
	(9.012)	(0.334)	(−0.634)	(−2.665)	
1986–1995	**0.016**	−0.041	−0.073	**−0.192**	0.039
	(10.046)	(−1.134)	(−1.112)	(−2.845)	
1996–2005	**0.011**	−0.091	−0.090	**−0.171**	0.034
	(5.339)	(−1.802)	(−1.355)	(−2.475)	

column five represents the coefficients on the intercept (alpha), Mkt_Rf, SMB and HML and the last column reports the adjusted *R*-squared of the regression. We provide strong evidence of statistically significant alpha of 0.01 ($t = 11.64$)[14] during the full sample period. However, the coefficient on the three Fama–French factors, Mkt_Rf, SMB and HML are 0.01, −0.03 and −0.02, respectively neither of which are statistically different from zero.

In different sub-periods results in Panel A shows that in six out of eight sub-periods alpha is positive and significant, and more pronounced during the post-1950s. For example, in sub-periods 1946–1955, 1956–1965, 1966–1975, 1976–1985, 1986–1995 and 1996–2005 alphas are 0.01, 0.01, 0.01, 0.01, 0.02 and 0.01, respectively all of which are statistically significant at one percent level. Conversely, alphas during the pre-1950s are comparatively weak e.g. in sub-periods 1926–1935 and 1936–1945 alphas are 0.01 and −0.001 and are not statistically different from zero. Similar to the findings of Jegadeesh and Titman (1996) who report that the coefficient of Fama–French three factors are negative when regressed against momentum return during the post 1950s. All the three factors of Fama–French are statistically insignificant with the exception of HML which is significant in the sub-periods 1976–1985 and 1986–1995 with coefficients of −0.15 and −0.13, respectively. The above evidence of positive and significant alphas suggests that significant momentum return remains after adjusting for the Fama–French factors.

Earlier studies document that momentum return is explained once the predictable components of stock returns when measured by lagged variables are considered (see Chordia & Shivakumar, 2002). One may naturally argue that the results might differ if the predicted Fama–French three factors as measured by the lag of these variables are accounted for. We answer this by re-estimating the results in Panel B of Table 2 using lagged Fama–French three factors as risk factors in the regression model. We report that the conclusion of a positive and statistically significant alpha remains unchanged even when the predictable components of the stock returns are accounted for. Panel B show that during the entire sample period alpha is positive and significant 0.01 ($t = 11.91$). This finding in consistent with that reported by Wang (2012) that the intercept of the regression is positive and statistically significant when using the Fama–French three factors at the portfolio level in their study. However the use of lagged variables changes the signs of the coefficients which indicates systematic differences across momentum return when exposed to Fama–French three factors as contemporaneous and lagged variables, though not statistically significant. Panel B confirms our earlier findings that the phenomenon of momentum return is particularly strong in post-1950s then in pre-1950s. For example, in the sub-periods 1946–1955, 1956–1965, 1966–1975, 1976–1985,1986–1995 and 1996–2005 alphas (*t*-statistics) are 0.009 (8.64), 0.011 (12.10), 0.007 (3.75), 0.014 (9.01), 0.016 (10.04) and 0.011 (5.33), respectively,

[14] All estimates are rounded to nearest estimates.

while in the sub-period 1926–1935 and 1936–1945 alpha are e.g. 0.007 and −0.002, respectively, which are not significant. The results are consistent in terms of the three Fama–French factors. For instance, in all sub-periods the coefficient on Mkt_Rf and SMB are insignificant except HML which is significant in the sub-periods 1956–1965, 1976–1985, 1986–1995 with coefficient of −0.116, −0.136, −0.192 and −0.171, respectively. One noticeable difference between the two above estimations is that on average the adjusted *R*-squared improves when lagged Fama–French factors are used compared to contemporaneous variables. This partially supports the explanation of earlier evidence that momentum return is better (though not entirely) explained when predicted variables are accounted for. The result is consistent with the study of Su (2011) who report that a delayed-reaction Fama–French three factor model provides a better measure of common risk and can explain up till 19 percent of momentum profits.

Our findings supplements to momentum literature in two ways; firstly, we report that alpha is positive and significant in different sub-periods and more pronounced during the post-1950s and pre-2000s. Earlier studies that report similar findings of the failure of Fama–French three-factor to explain momentum return, on average, considered a whole sample period. For instance, Jegadeesh and Titman (2001) study the effect on the whole sample period from 1965 to 1989, Fama-French (1996) examined from 1963 through 1993. Our study adds that the results are consistent and significant and are unique in each sub-sample period. Secondly, we show that even when Fama–French factors are employed as predictor variables the conclusion of statistically significant alpha does not change. This finding leaves room for researchers to rethink about the association between predictor variables and momentum return.

4.1.2. Does momentum return remain after adjusting for macroeconomic factors at the portfolio level?

Our empirical results in Table 4 hold when the only risk factors are the Fama–French three factors. Chordia and Shivakumar (2002) claim that momentum return can be explained by a parsimonious set of macro economic variables, when the lagged of these variables, are employed at the individual stock level. In the following section we provide evidence on whether the alpha is zero when macroeconomic factors are the risk factors in the model. Panel A of Table 3 shows that when contemporaneous macroeconomic variables are used alpha is 0.02 ($t = 12.63$) and significantly different from zero during the entire sample period. One the other hand, the coefficients of all the macroeconomic variables are negative except that of DIV which is positive but insignificant. In the entire sample period only the variable TERM is statistically significant with a coefficient −0.004 ($t = -4.63$). Similar to the findings of Table 4 except in the sub-period 1936–1945, alpha is positive in all other sub-periods and statistically significant in the post-1950s. For example, in the sub-periods 1946–1955, 1956–1965, 1966–1975, 1976–1985, 1986–1995, 1995–2005 and alpha (*t*-statistics)

Table 3
Portfolio Analysis: Momentum Strategy Returns Regressed on Macroeconomic Variables: Ten-year Sub-Period Results. Winner, Loser and Momentum portfolios are formed based on the strategy described in Table 1 for the strategy excluding penny stocks with a strategy of JxK = 6x6. The following table represents the coefficients and the *t*-statistics obtained when momentum returns are regressed against the macroeconomic four factor variables, e.g. DIV, YLD, TERM and DEF. The macro factors are dividend yield (DIV), short rate (YLD), term premium (TERM) and the default premium (DEF). DIV is defined as the total dividend payment accrued to the CRSP value-weighted market index over the past 12 months divided by the current price level of the index. YLD is the yield on the three-month Treasury bill. TERM is defined as the yield spread of a ten-year Treasury bond and a three-month Treasury bill and DEF is the yield spread of Moody's Baa and Aaa rated bonds. The regressions are $MR_{t*,6x6} = \alpha + \sum_{j=1}^{n} \beta_j X_{t*} + \varepsilon_{t*}$ and $MR_{t*,6x6} = \alpha + \sum_{j=1}^{n} \beta_j X_{t*-1} + \varepsilon_{t*}$ where *X* is the vector of the macroeconomic factors both as contemporaneous and as lagged variables. The regressions are carried out separately for each sub-period. The coefficient covariance of the regression is derived from White's heteroskedasticity consistent coefficient covariance. Panel A shows the output for the Fama–French three factor variables when used as contemporaneous variables whilst Panel B reports the regression output when these variables are used as predictor variables over different sub-periods. The number in bold fonts represents significance at 5 percent level, *t*-statistics are reported in parenthesis and adjusted *R*-squared is also given.

Panel A: macroeconomic factors as contemporaneous variables

Period	Alpha	DIV	YLD	TERM	DEF	Adj *R*-squared
1926–2005	**0.015**	0.003	−0.001	**−0.004**	−0.005	0.054
	(12.639)	(1.005)	(−0.571)	(−4.628)	(−0.398)	
1926–1935	0.007	0.010	−0.016	−0.012	−0.038	−0.009
	(1.838)	(1.270)	(−0.491)	(−0.300)	(−0.754)	
1936–1945	−0.001	0.004	−0.012	−0.009	−0.009	−0.030
	(−0.674)	(0.799)	(−0.388)	(−0.256)	(−0.300)	
1946–1955	**0.009**	0.001	−0.015	−0.017	0.003	−0.027
	(9.589)	(0.215)	(−1.103)	(−1.218)	(0.133)	
1956–1965	**0.011**	0.003	−0.003	−0.001	0.027	−0.017
	(11.313)	(0.379)	(−0.202)	(−0.070)	(1.040)	
1966–1975	**0.007**	0.018	−0.004	−0.016	0.017	0.037
	(3.233)	(1.435)	(−0.309)	(−0.950)	(0.637)	
1976–1985	**0.013**	−0.016	0.003	0.000	0.009	0.011
	(8.849)	(−1.855)	(0.513)	(−0.001)	(0.712)	
1986–1995	**0.015**	−0.010	**−0.012**	0.003	**0.068**	0.075
	(10.418)	(−1.065)	(−2.572)	(0.519)	(3.109)	
1996–2005	**0.010**	−0.007	−0.009	0.001	**0.008**	0.060
	(8.292)	(−1.002)	(−1.012)	(0.526)	(2.022)	

Panel B: macroeconomic factors as lagged variables

Period	Alpha	DIV_{t-1}	YLD_{t-1}	$TERM_{t-1}$	DEF_{t-1}	Adj *R*-squared
1926–2005	**0.014**	0.005	0.001	**−0.003**	0.014	0.054
	(12.064)	(1.069)	(0.690)	(−4.165)	(0.962)	
1926–1935	0.007	0.002	0.018	0.020	0.020	−0.010
	(1.691)	(0.453)	(0.588)	(0.454)	(0.311)	
1936–1945	−0.001	0.006	0.015	0.018	0.013	−0.019
	(−0.575)	(0.964)	(0.463)	(0.651)	(0.391)	
1946–1955	**0.009**	0.000	−0.021	−0.008	0.008	−0.006
	(9.873)	(−0.073)	(−1.489)	(−0.537)	(0.331)	
1956–1965	**0.011**	**0.016**	0.002	−0.002	0.011	0.016
	(10.982)	(2.606)	(0.135)	(−0.137)	(0.367)	
1966–1975	**0.009**	0.020	−0.006	−0.020	0.015	0.039
	(3.859)	(1.142)	(−0.331)	(−1.104)	(0.487)	
1976–1985	**0.013**	−0.009	0.006	0.003	0.017	0.002
	(8.857)	(−1.411)	(0.999)	(0.438)	(1.298)	
1986–1995	**0.015**	0.010	−0.009	−0.008	**0.059**	0.052
	(10.243)	(1.044)	(−1.848)	(−1.277)	(2.177)	
1996–2005	**0.008**	0.016	−0.068	−0.009	0.061	0.047
	(9.172)	(1.012)	(−1.458)	(−1.223)	(1.177)	

Table 4
Individual Stock Level Analysis: Momentum Return Based on Alternative Strategies At the Individual Stock Level Using Contemporaneous Fama–French Factors as Risk factors: Ten-Year Sub-Period Results. The following table reports the monthly returns in percentage based on alternative momentum strategies. For each month t, the following model is estimated for each NYSE, AMEX and NASDAQ stock on the monthly CRSP database (using a sixty-month window and a minimum of 24 months of data required):$R_{it} = \alpha_i + \sum_{j=1}^{n} \beta_{ij} f_t + \varepsilon_{it}$, where, R_{it} is the return of each stock at time t, f_t is the vector of Fama–French factors e.g. the monthly return on CRSP value-weighted market index in excess of the one-month Treasury bill rate, the Small-Minus-Big size factor and the High-Minus-Low book-to- market- ratio factor, β_{ij} is the factor loadings α_i and ε_{it} are constant and residual, respectively. Thereafter the model is decomposed into two components e.g. the stock specific components $(\widehat{\alpha}_i + \widehat{\varepsilon}_{it})$ and the risk factors $(\sum_{j=1}^{n} \widehat{\beta}_{ij} f_t)$. Stocks are ranked based on these two criterions using a formation period J of five months ($t-5$ *through* $t-1$) and deciles portfolios are formed with the loser the lowest portfolio and winner the highest portfolios. The winner portfolio is held long and the loser portfolio is held short for the following K ($t+1$ *through* $t+6$) holding month. The momentum return is defined as the difference between the return on the winner and the loser portfolio. The returns exclude all penny stocks. Panel A reports the returns of loser, winner and momentum portfolio where stocks are ranked based on idiosyncratic factor, while Panel B reports the same while stocks are ranked based on risk factors. The column 'Decile portfolio size' reports the average size of the decile portfolio during each period. The column titled "% > 0"gives the percentage of Winner minus Loser that are positive. The last column reports the size of each sub-sample period. The estimates are reported in percentage, the number in bold fonts represent significance at the 5 percent level and t-statistics are also given.

Panel A: ranking based on idiosyncratic risk								Panel B: ranking based on risk factors							
Period		Loser	Winner	MR_{t*}^{I}	Decile portfolio size	% > 0	No. of months	Period		Loser	Winner	$MR_{t*}^{RiskFac}$	Decile portfolio size	% > 0	No. of months
1926–2005	Return	1.505	1.924	**0.420**	260	61.15%	895	1926–2005	Return	1.409	1.789	**0.379**	319	54.00%	895
	t-Stat	10.133	13.895	7.800					t-Stat	10.359	12.521	3.337			
1926–1935	Return	3.380	4.300	**0.920**	64	30.83%	55	1926–1935	Return	1.570	1.780	0.210	36	27.25%	55
	t-Stat	3.859	4.816	4.288					t-Stat	3.518	4.055	0.524			
1936–1945	Return	2.490	2.290	−0.200	72	44.17%	120	1936–1945	Return	2.175	2.520	0.350	75	63.33%	120
	t-Stat	5.290	5.165	−1.097					t-Stat	4.772	5.687	0.879			
1946–1955	Return	0.830	1.540	**0.710**	90	76.67%	120	1946–1955	Return	0.945	1.465	**0.520**	92	65%	120
	t-Stat	3.292	7.362	8.221					t-Stat	5.260	5.435	3.241			
1956–1965	Return	0.720	1.460	**0.750**	108	82.50%	120	1956–1965	Return	0.825	1.200	**0.375**	114	55.00%	120
	t-Stat	3.323	8.012	9.033					t-Stat	4.426	5.740	2.600			
1966–1975	Return	0.520	1.070	**0.550**	210	63.33%	120	1966–1975	Return	0.600	0.795	0.195	236	51.67%	120
	t-Stat	1.248	2.933	3.677					t-Stat	1.608	2.175	0.696			
1976–1985	Return	1.640	2.350	**0.700**	416	68.33%	120	1976–1985	Return	1.515	2.200	**0.685**	494	64.17%	120
	t-Stat	5.618	8.196	6.070					t-Stat	5.989	7.475	3.821			
1986–1995	Return	1.400	1.640	0.230	488	65.00%	120	1986–1995	Return	1.475	1.445	−0.030	626	49.17%	120
	t-Stat	4.236	6.351	1.615					t-Stat	5.983	5.309	−0.173			
1996–2005	Return	2.080	2.050	−0.030	526	58.33%	120	1996–2005	Return	1.555	2.095	0.545	709	59.17%	120
	t-Stat	5.424	5.741	−0.170					t-Stat	4.572	5.266	1.799			

is 0.01 (9.59), 0.01 (11.31), 0.001 (3.23), 0.01 (8.85), 0.02 (10.42) and 0.01 (8.929) respectively. On average the macroeconomic variables are insignificant across different sub-periods except YLD and DEF which are significant in only two sub-period 1986–1995 with coefficient of −0.01 ($t = -2.57$) and 0.07 ($t = 3.11$), respectively. The above findings of positive and significant alpha confirm that momentum return remains even after adjusted for the market wide contemporaneous macroeconomic factors at the portfolio level.

For further evidence on whether or not lagged macroeconomic variable, as claimed by Chordia and Shivakumar (2002) can alter the conclusion drawn in the previous section we reproduce the estimates. As reported in Panel B of Table 5 in the full sample period alpha is significantly different from zero with coefficient 0.01 ($t = 2.06$). Among the four macro economic variables only TERM is significant with a coefficient −0.003 ($t = -4.17$). Again alphas in the post 1950s are stronger than in pre-1950s. For example, in sub-periods 1946–1955, 1956–1965, 1966–1975, 1976–1985, 1986–1995 and 1995–2005 alphas are 0.01, 0.01, 0.01, 0.01, 0.02 and 0.01 respectively and are all significant at one percent level.

In sum, the results of Tables 2 and 3 demonstrate that alpha is positive and significant during the entire sample period and on average in different sub-periods. This conclusion holds for both Fama–French three factors and macroeconomic factors when used as contemporaneous variable. Secondly, the results of a significant positive alpha do not change even when lagged variables are accounted for, however only the adjusted R-squared improves. This partly supports the evidence of early literature that momentum return is better explained once the predictable component of stock returns is accounted for. Thirdly, our results are more pronounced during upmarket e.g. post-1950s and pre-2000s which implies that the momentum return is closely linked to business cycle. These consistent findings in different sub-periods assert that the results are not driven by a particular sub-period.[15] Overall, the results strongly reject the null hypothesis of a zero intercept and conclude that momentum returns are not eliminated once

[15] US market experience several economic downturns during the pre-1940s (e.g. late 1920s and early 1930s) and post-2000s (e.g. late 1990s and early 2000s).

Table 5
Individual Stock Level Analysis: Momentum Return Based on Alternative Strategies At the Individual Stock Level Using Lagged Fama–French Factors as risk factors: Ten-Year Sub-Period Results. The following table reports the monthly returns in percentage based on alternative momentum strategies. For each month t, the following model is estimated for each NYSE, AMEX and NASDAQ stock on the monthly CRSP database (using a sixty-month window and a minimum of 24 months of data required): $R_{it} = \alpha_i + \sum_{j=1}^{n} \beta_{ij} f_{t-1} + \varepsilon_{it}$, where, R_{it} is the return of each stock at time t, f_{t-1} is the vector of Fama–French factors, β_{ij} is the factor loadings α_i and ε_{it} are constant and residual, respectively. Thereafter the model is decomposed into two components e.g. the stock specific components $(\widehat{\alpha}_i + \widehat{\varepsilon}_{it})$ and the risk factors $(\sum_{j=1}^{n} \widehat{\beta}_{ij} f_{t-1})$. Stocks are ranked based on these two criterions using a formation period J of five months ($t-5$ *through* $t-1$) and deciles portfolios are formed with the lowest (P1) portfolio as the loser and highest portfolios (P10) as the winner portfolio. A long position in taken in the winner portfolio and short position in the loser portfolio and hold the position for the following K ($t+1$ *through* $t+6$) holding month. The momentum return is defined as the difference between the return on the winner and the loser portfolio. The returns exclude all penny stocks. Panel A reports the returns of loser, winner and momentum portfolio where stocks are ranked based on idiosyncratic factor, while Panel B reports the same while stocks are ranked based on risk factors. The column 'Decile portfolio size' reports the average size of the decile portfolio during each period. The column titled "% > 0"gives the percentage of Winner minus Loser that are positive. The last column reports the size of each sub-sample period. The estimates are reported in percentage, the number in bold fonts represent significance at the 5 percent level and t-statistics are also given.

Panel A: ranking based on idiosyncratic risk

Period		Loser	Winner	MR^{I}_{t*}	Decile portfolio size	% > 0	No. of months
1926–2005	Return	1.513	1.963	**0.450**	260	64.00%	895
	t-Stat	9.941	14.357	6.148			
1926–1935	Return	4.020	4.180	0.160	64	29.17%	55
	t-Stat	4.125	4.915	0.339			
1936–1945	Return	2.440	2.370	−0.070	72	50.00%	120
	t-Stat	5.244	5.186	−0.279			
1946–1955	Return	0.720	1.570	**0.840**	90	84.17%	120
	t-Stat	3.116	7.004	10.606			
1956–1965	Return	0.640	1.510	**0.870**	108	87.50%	120
	t-Stat	3.046	7.922	10.131			
1966–1975	Return	0.530	1.100	**0.570**	210	63.33%	120
	t-Stat	1.275	3.067	2.954			
1976–1985	Return	1.550	2.450	**0.900**	416	75.00%	120
	t-Stat	5.487	8.672	7.547			
1986–1995	Return	1.430	1.630	0.200	488	65.83%	120
	t-Stat	4.353	6.296	1.302			
1996–2005	Return	2.160	2.130	−0.040	526	55.83%	120
	t-Stat	5.653	6.050	−0.185			

Panel B: ranking based on risk factors

Period		Loser	Winner	$MR^{RiskFac}_{t*}$	Decile portfolio size	% > 0	No. of months
1926–2005	Return	1.465	1.849	**0.385**	319	59.00%	895
	t-Stat	10.917	12.289	5.710			
1926–1935	Return	1.475	2.355	**0.880**	36	27.50%	55
	t-Stat	3.663	4.738	3.892			
1936–1945	Return	2.125	2.45	0.325	75	56.67%	120
	t-Stat	4.973	5.469	1.566			
1946–1955	Return	1.085	1.24	0.155	92	48%	120
	t-Stat	5.244	5.283	1.731			
1956–1965	Return	0.95	1.14	**0.190**	114	60.00%	120
	t-Stat	4.560	6.187	2.415			
1966–1975	Return	0.71	1.045	0.335	236	55.84%	120
	t-Stat	1.763	2.679	1.872			
1976–1985	Return	1.925	2.155	**0.230**	494	60.83%	120
	t-Stat	7.024	7.055	2.294			
1986–1995	Return	1.18	1.565	**0.380**	626	60.00%	120
	t-Stat	4.595	5.270	3.040			
1996–2005	Return	1.62	2.09	**0.470**	709	63.33%	120
	t-Stat	4.560	5.207	2.332			

accounted for common components, be it contemporaneous or lagged at the portfolio level.

4.2. Individual level analysis

One may now rationally think whether the results of significant alpha at the portfolio level also hold for individual stock level. The intuition arises as contemporary momentum literature documents that the effect of momentum return and the explanatory power of market wide common factors are significant at stock level (see also Wu (2006) and Chordia & Shivakumar, 2002). Given the argument we are interested in whether or not momentum return is generated from idiosyncratic risk once adjusted for common risk factors. This is because if risk factors can explain momentum return at the individual stock level then we expect to see no momentum return resulting from idiosyncratic risk.

4.2.1. Does momentum return remains after adjusting for Fama–french three factors at the individual stock level?

Panel A of Table 4 reports the monthly momentum return estimated at the individual stock level when the contemporaneous Fama–French factors are the risk factors. We apply the same approach of estimating the result for the entire sample period and then for each eight sub-sample period. Using alternative momentum strategies e.g. when stocks are ranked based on the estimated idiosyncratic risk, the first three columns represent the Loser, Winner and momentum portfolio, respectively. The column 'Decile Portfolio Size' represents the average number of stocks in the decile portfolio during each period and the column titled '% > 0' shows the total percentage of the momentum return that is greater than zero. Given the assumptions of skipping a month, a strategy of $JxK = 6x6$ and a window of sixty-month the total number of months in the sample period is 960 (from January 1926 through 2005). A total of 65 months is lost and the first momentum return is realized at the end of the holding period. Therefore when the entire sample period is considered the total number of months is brought down to 895 months. Hence during the sub-period 1926 through 1935 the total number of months is 55 (lost 65 observations). Thereafter in all subsequent sub-periods the total number of months is 120.

As evident from Panel A of Table 4, during the entire sample period from 1926 through 2005 monthly momentum return (MR^{I}_{t*}), when stocks are ranked based on the stock-specific factors or idiosyncratic risk $(\widehat{\alpha}_i + \widehat{\varepsilon}_{it})$, is 0.42 percent (an average of 5.04 percent per annum) and is statistically significant of which 61.15 percent of the return is positive and the average portfolio size is 260 stocks. In different sub-periods momentum return seems to be consecutively significant and positive during the post 1940s, e.g. momentum return is 0.71 percent in 1946—1955, 0.75 percent in 1956—1965, 0.55 percent in 1966—1975, and 0.70 percent in 1976—1985 and are significant at one percent level. With the exception in 1936—1945 and 1996—2005 when momentum return is negative e.g. −0.20 percent and −0.03 percent in all other sub-periods the returns are positive. Conversely, Panel B of Table 8 which reports momentum return when stocks are sorted based on the risk factors $(\sum_{j=1}^{N} \widehat{\beta}_{ij} f_t)$ e.g. contemporaneous Fama—French factors, generates a momentum return ($MR_{t^*}^{Riskfac}$) of 0.37 percent and significant during the entire sample period. The total portfolio size is 319 stocks with only 59 percent of the return greater than zero. However, in different sub-periods only three out of eight sample periods momentum return is positive and significant and the phenomenon is particularly distinct in post-1940s e.g. momentum return is 0.52 percent ($t = 3.24$) in 1946—1955, 0.37($t = 2.6$) in 1956—1965 and 0.68 ($t = 3.8$) in 1976—1985.

Our results on the lagged Fama—French factors are consistent with that of the contemporaneous Fama—French factors. Panel A of Table 4 reports that $MR_{t^*}^{I}$ is 0.45 percent and is significant during the whole sample period and with a portfolio size of 260 stocks the percentage of return that is positive is 64 percent. In different sub-periods $MR_{t^*}^{I}$ is greater than zero and significant in four consecutive sub-periods from 1946 to 1985. For instance $MR_{t^*}^{I}$ is 0.84 percent in 1946—1955, 0.87 percent in 1956—1965, 0.57 percent in 1966—1975 and 0.9 percent in 1976—1985. Also in the sub-periods 1936—1945 and 1996—2005 momentum return is less than zero e.g. −0.07percent and −0.04 percent, respectively. Notably, momentum return is more significant in most periods when stocks are ranked based on lagged Fama—-French factors as compared when contemporaneous factors are considered. For example, Panel B of Table 7 exhibits that with the exceptions in the sub-periods 1936—1945, 1946—1955 and 1966—1975 in all other sub-periods momentum return is positive and statistically significant. The percentage of return greater than zero during these periods is on average 54.33 percent. Again during the entire sample period $MR_{t^*}^{Riskfac}$ is 0.38 percent with 59 percent of the return greater than zero.

In sum, our results from Tables 4 and 5 provide evidence that return generated from $MR_{t^*}^{I}$ is more significant than those from $MR_{t^*}^{Riskfac}$. For instance, in different sub-periods on average $MR_{t^*}^{I}$ generates 0.45 percent momentum return while only 0.35 percent is generated from $MR_{t^*}^{Riskfac}$. This implies that momentum return still remains when accounted for Fama—-French factors at the individual stock level. Though during the two-ends of the sample period when there were economic downturns e.g. pre-1940s and post 2000s $MR_{t^*}^{I}$ are negative while $MR_{t^*}^{Riskfac}$ are positive both in cases when Fama—French are considered as contemporaneous and as lagged common components, it is not statistically significant. This implies that significant momentum return remains after controlling for the Fama—French three factors at the individual stock level, particularly during market upturn.

4.2.2. *Does momentum return remains after adjusting for macroeconomic factors at the individual stock level?*

As shown in Panel A of Table 6 when stocks are ranked based on the contemporaneous macroeconomic factors $MR_{t^*}^{I}$ is 0.159 ($t = 2.57$) during the whole sample period of which 63 percent is positive. Again in different sub-periods only in the pre-1940s $MR_{t^*}^{I}$ is positive and significant e.g. in 1926—1935 $MR_{t^*}^{I}$ is 1.31 percent, 0.83 percent in 1936—1945 and 0.35 percent in 1946—1955. In the post-1940s $MR_{t^*}^{I}$ is mostly negative but statistically significant only in two sub-sample periods, e.g. 1976—1985 (−0.3 percent, $t = -2.18$) and in 1986—1995 (−0.19 percent, $t = -1.97$). Noticeably, $MR_{t^*}^{I}$ is negative during the period from 1956 through 1995. This reveals that when adjusted for macroeconomic variables there is no momentum return generating from idiosyncratic risk during the Chordia and Shivakumar (2002). This implies that the findings of Chordia and Shivakumar (2002) could be more to the interaction of momentum return across market movements then to the predictability of macroeconomic variable. Our results support this hypothesis as we report positive and significant momentum return generating from idiosyncratic components, which shows the presence of momentum return, before and after the Chordia and Shivakumar period e.g. the period when market was falling.

When momentum returns are produced by sorting stocks based on the contemporaneous macroeconomic variable, we report positive and, on average, significant momentum return generating from $MR_{t^*}^{Riskfac}$ during the Chordia and Shivakumar period, supporting our argument that during the period of market upturn macroeconomic factors do explain most momentum return. For example, Panel B of Table 6 report that in 1956—1965 0.20 percent ($t = 1.879$), 1966—1975 0.22 percent ($t = 1.89$), 1976—1985 0.39 percent ($t = 2.760$), 1986—1995 0.21 percent ($t = 2.064$). During the pre-1940s $MR_{t^*}^{Riskfac}$ is negative indicating no momentum return during market downturn e.g. in 1926—1935, 1936—1945 and 1946—1955 $MR_{t^*}^{Riskfac}$ is −1.9 percent ($t = -4.84$), −0.81 percent ($t = -2.71$) and −0.28 percent ($t = -2.28$). However though $MR_{t^*}^{Riskfac}$ is positive during the post-2000s, but not statistically significant.

For the lagged macroeconomic variables, Panel A of Table 7 shows that $MR_{t^*}^{I}$ is negative in almost all periods indicating no momentum return generated from $MR_{t^*}^{I}$. Also during the entire sample period $MR_{t^*}^{I}$ is −0.15 percent of which 49.19 percent is positive and where the portfolio size comprises of 247 stocks. On the other hand, most of the momentum returns as generated when stocks are sorted based on the lagged macroeconomic factors. As reported in Panel B of Table 7 during the entire sample period $MR_{t^*}^{Riskfac}$ is 0.22 percent with t-statistics of 3.614. Except in two periods e.g. 1946—1955 (−0.18 percent, $t = -2.11$) and in 1996—2005 (−2.9 percent, $t = -2.268$) in all other sub-periods momentum return is positive including the Chordia and Shivakumar (2002) period. Therefore, when

Table 6
Individual Stock Level Analysis: Momentum Return Based on Alternative Strategies At the Individual Stock Level Using Contemporaneous Macroeconomic Factors as risk factors: Ten-Year Sub-Period Results. The following table reports the monthly returns in percentage based on alternative momentum strategies. For each month *t*, the following model is estimated for each NYSE, AMEX and NASDAQ stock on the monthly CRSP database (using a sixty-month window and a minimum of 24 months of data required):$R_{it} = \alpha_i + \sum_{j=1}^{n} \beta_{ij} f_t + \varepsilon_{it}$, where, R_{it} is the return of each stock at time *t*, f_t is the vector of Macroeconomic factors e.g. dividend yield (DIV) defined as the total dividend payment accrued to the CRSP value-weighted market index over the past 12 months divided by the current price level of the index, short rate (YLD) is the yield on the three-month Treasury bill, term premium (TERM) is defined as the yield spread of a ten-year Treasury bond and a three-month Treasury bill and the default premium (DEF) is the yield spread of Moody's Baa and Aaa rated bonds,β_{ij} is the factor loadings α_i and ε_{it} are constant and residual, respectively. Thereafter the model is decomposed into two components e.g. the stock specific components $(\widehat{\alpha}_i + \widehat{\varepsilon}_{it})$ and the risk factors $(\sum_{j=1}^{n} \widehat{\beta}_{ij} f_t)$. Stocks are ranked based on these two criterions using a formation period *J* of five months ($t-5$ *through* $t-1$) and deciles portfolios are formed with the lowest (P1) portfolio as the loser and highest portfolios (P10) as the winner portfolio. A long position in taken in the winner portfolio and short position in the loser portfolio and hold the position for the following *K* ($t+1$ *through* $t+6$) holding month. The momentum return is defined as the difference between the return on the winner and the loser portfolio. The returns exclude all penny stocks. Panel A reports the returns of loser, winner and momentum portfolio where stocks are ranked based on idiosyncratic factor, while Panel B reports the same while stocks are ranked based on risk factors. The column 'Decile portfolio size' reports the average size of the decile portfolio during each period. The column titled "% > 0"gives the percentage of Winner minus Loser that are positive. The last column reports the size of each sub-sample period. The estimates are reported in percentage, the number in bold fonts represent significance at the 5 percent level and *t*-statistics are also given.

Panel A: Ranking based on idiosyncratic risk								Panel B: Ranking based on risk factors							
Period		Loser	Winner	MR^{I}_{t*}	Decile portfolio size	% > 0	No. of months	Period		Loser	Winner	$MR^{RiskFac}_{t*}$	Decile portfolio size	% > 0	No. of months
1926–2005	Return	1.467	1.626	**0.159**	247	63.00%	895	1926–2005	Return	1.573	1.503	−0.070	302	50.15%	895
	t-Stat	11.268	10.737	2.571					*t*-Stat	10.412	11.404	−1.129			
1926–1935	Return	3.220	4.530	**1.310**	64	29.17%	55	1926–1935	Return	4.360	3.270	**−1.090**	71	16.67%	55
	t-Stat	3.715	4.441	5.091					*t*-Stat	4.468	3.816	−4.847			
1936–1945	Return	1.610	2.430	**0.830**	72	59.17%	120	1936–1945	Return	2.410	1.600	**−0.810**	75	42.50%	120
	t-Stat	4.892	5.113	2.860					*t*-Stat	5.073	4.944	−2.717			
1946–1955	Return	0.980	1.330	**0.350**	90	60.00%	120	1946–1955	Return	1.310	1.030	**−0.280**	92	43%	120
	t-Stat	5.220	5.120	2.936					*t*-Stat	4.934	5.538	−2.287			
1956–1965	Return	1.080	0.980	−0.100	108	49.17%	120	1956–1965	Return	0.940	1.140	0.200	114	52.50%	120
	t-Stat	6.709	4.764	−0.987					*t*-Stat	4.537	6.943	1.879			
1966–1975	Return	0.670	0.560	−0.110	210	47.50%	120	1966–1975	Return	0.470	0.690	0.220	236	57.50%	120
	t-Stat	1.780	1.431	−0.857					*t*-Stat	1.189	1.796	1.890			
1976–1985	Return	2.060	1.750	**−0.300**	416	36.67%	120	1976–1985	Return	1.690	2.090	**0.390**	494	60.83%	120
	t-Stat	9.263	5.674	−2.180					*t*-Stat	5.337	9.074	2.760			
1986–1995	Return	1.360	1.170	**−0.190**	488	40.00%	120	1986–1995	Return	1.130	1.340	**0.210**	626	62.50%	120
	t-Stat	4.722	4.563	−1.976					*t*-Stat	4.251	4.539	2.064			
1996–2005	Return	1.720	1.840	0.120	526	53.33%	120	1996–2005	Return	1.800	1.840	0.040	709	53.33%	120
	t-Stat	4.522	5.502	0.848					*t*-Stat	4.972	4.521	0.258			

macroeconomic variables are considered momentum return reduces but only during market upturn.

In summary, the results of Tables 6 and 7 show that when macroeconomic factors are considered, there is less or no momentum return resulting from MR^{I}_{t*} while most of the payoff generates from $MR^{Riskfac}_{t*}$. This implies that macroeconomic variable can explain momentum return at the individual stock level but is conditioned to market state. The results are stronger during market expansions particularly in Chordia and Shivakumar (2002) period. This conclusion holds for both contemporaneous and lagged macroeconomic variables with more significant results for predictor variables.

4.2.3. Does momentum return remains after adjusting for both Fama–French three-factor and macroeconomic components at the individual stock level

Our empirical estimates at the individual stock level show that the two risk factors e.g. Fama–French three factors and macroeconomic factors have different effect on momentum phenomenon. One might then wonder whether the combined effect of both the Fama–French three factors and the macroeconomic factors could change the conclusion drawn to this end. Also which common component has more impact on momentum return? In the following section we explore this and replicate the results in Table 8 where both the market wide risk factors are accounted for. In Panel A of Table 8 we report that when stocks are sorted based on the contemporaneous common factors results are somewhat mixed but resembles the effect as reported in Table 8 when macroeconomic factors are in play. During the Chordia and Shivakumar (2002) period MR^{I}_{t*} is negative with the only exception in 1966–1975 when it is positive and significant e.g. 0.26 percent ($t = 2.97$). On the other hand Panel B of Table 8 shows that $MR^{Riskfac}_{t*}$ produces more significant return especially during the C–S period e.g. 1956–1965 0.08 ($t = 1.29$), 1966–1975 (−0.24 percent, $t = -2.59$), 1976–1985 (0.23 percent, $t = 2.09$) and in 1986–1995 (0.29 percent, $t = 2.77$) indicating that the impact of macroeconomic variables on momentum return is more compared to Fama–French factors, particularly during market upturns.

We report patterns when the two risk factors e.g. Fama–-French three factors and the macroeconomic factors are

Table 7
Individual Stock Level Analysis. Momentum Return Based on Alternative Strategies At the Individual Stock Level Using Lagged Macroeconomic Factors as risk factors: Ten-Year Sub-Period Results. The following table reports the monthly returns in percentage based on alternative momentum strategies. For each month t, the following model is estimated for each NYSE, AMEX and NASDAQ stock on the monthly CRSP database (using a sixty-month window and a minimum of 24 months of data required): $R_{it} = \alpha_i + \sum_{j=1}^{n} \beta_{ij} f_{t-1} + \varepsilon_{it}$, where, R_{it} is the return of each stock at time t, f_{t-1} is the vector of macroeconomic factors, β_{ij} is the factor loadings α_i and ε_{it} are constant and residual, respectively. Thereafter the model is decomposed into two components e.g. the stock specific components $(\widehat{\alpha}_i + \widehat{\varepsilon}_{it})$ and the risk factors $(\sum_{j=1}^{n} \widehat{\beta}_{ij} f_{t-1})$. Stocks are ranked based on these two criterions using a formation period J of five months ($t-5$ *through* $t-1$) and deciles portfolios are formed with the lowest (P1) portfolio as the loser and highest portfolios (P10) as the winner portfolio. A long position in taken in the winner portfolio and short position in the loser portfolio and hold the position for the following K ($t+1$ *through* $t+6$) holding month. The momentum return is defined as the difference between the return on the winner and the loser portfolio. The returns exclude all penny stocks. Panel A reports the returns of loser, winner and momentum portfolio where stocks are ranked based on idiosyncratic factor, while Panel B reports the same while stocks are ranked based on risk factors. The column 'Decile portfolio size' reports the average size of the decile portfolio during each period. The column titled "%>0"gives the percentage of Winner minus Loser that are positive. The last column reports the size of each sub-sample period. The estimates are reported in percentage, the number in bold fonts represent significance at the 5 percent level and t-statistics are also given.

Panel A: ranking based on idiosyncratic risk

Period		Loser	Winner	MR^{I}_{t*}	Decile portfolio size	% > 0	No. of months
1926–2005	Return	1.666	1.511	**−0.155**	247	49.19%	895
	t-Stat	11.192	11.510	−2.665			
1926–1935	Return	4.01	3.81	−0.200	64	28.33%	55
	t-Stat	4.060	4.602	−0.604			
1936–1945	Return	2.86	1.51	**−1.350**	72	27.50%	120
	t-Stat	6.102	4.429	−6.172			
1946–1955	Return	0.99	1.24	**0.250**	90	59.17%	120
	t-Stat	4.139	5.880	3.057			
1956–1965	Return	1.01	0.97	−0.040	108	47.50%	120
	t-Stat	5.987	4.661	−0.383			
1966–1975	Return	0.64	0.72	0.080	210	53.33%	120
	t-Stat	1.670	1.787	0.735			
1976–1985	Return	2.19	1.9	**−0.290**	416	49.17%	120
	t-Stat	8.066	6.448	−2.289			
1986–1995	Return	1.25	1.23	−0.020	488	58.33%	120
	t-Stat	4.111	4.959	−0.152			
1996–2005	Return	1.69	1.99	**0.310**	526	65.00%	120
	t-Stat	4.489	5.830	2.558			

Panel B: ranking based on risk factors

Period		Loser	Winner	$MR^{RiskFac}_{t*}$	Decile portfolio size	% > 0	No. of months
1926–2005	Return	1.481	1.700	**0.219**	302	52.13%	895
	t-Stat	11.096	11.186	3.614			
1926–1935	Return	3.89	4.15	0.250	71	19.17%	55
	t-Stat	4.726	4.234	0.758			
1936–1945	Return	1.48	2.93	**1.450**	75	74.17%	120
	t-Stat	4.420	6.150	6.018			
1946–1955	Return	1.2	1.02	**−0.180**	92	42.50%	120
	t-Stat	5.734	4.238	−2.109			
1956–1965	Return	0.93	1.03	0.100	114	55.00%	120
	t-Stat	4.490	6.003	0.863			
1966–1975	Return	0.63	0.7	0.070	236	53.33%	120
	t-Stat	1.529	1.803	0.640			
1976–1985	Return	1.89	2.18	**0.290**	494	50.00%	120
	t-Stat	6.188	7.197	2.199			
1986–1995	Return	1.19	1.26	0.070	626	46.67%	120
	t-Stat	4.644	4.101	0.552			
1996–2005	Return	1.97	1.69	**−0.290**	709	39.17%	120
	t-Stat	5.406	4.182	−2.268			

considered as lagged common components. As shown in Panel A of Table 9, in different sub-periods the results are mixed. For instance, MR^{I}_{t*} is 0.59 percent in 1926–1935, −1.55 percent in 1936–1945, 0.33 percent in 1946–1955, 0.20 percent in 1966–1975, −0.31 percent in 1976–1985 and 0.46 percent in 1996–2005. Interestingly, the pattern of return when generated by ranking stocks on the two lagged risk factors are similar to that reported in Panel B of Table 9 where lagged macroeconomic factors were considered. Similar to our earlier findings we report that the effect of macroeconomic variable is far more crucial on momentum return than Fama–French factors. As shown in Panel B of Table 9 in the same sub-periods e.g. in sub-periods 1936–1945, 1946–1955, 1976–1985 and 1996–2005 $MR^{Riskfac}_{t*}$ is 1.57 percent, −0.27 percent, 0.27 percent and −0.39 percent, respectively and statistically significant. We also report that during the Chordia and Shivakumar (2002) period e.g. from 1953 through 1994 $MR^{Riskfac}_{t*}$ is significant only in the sub-period 1976–1985.

To recap, the following conclusions can be made based on the results from Tables 4 to 9. Firstly, when Fama–French factors are considered as risk factors, momentum return still remains at the individual stock level as significant momentum return is generated from idiosyncratic components. However when macroeconomic variables are considered much of the return is explained by these risk factors at the individual stock level as huge momentum return result from the macroeconomic variables, particularly during market upturn. When combining both Fama–French factors and macroeconomic factors the result is mixed which could be due to the opposite effect of Fama–French three factors and macroeconomic factors in explaining momentum return. On average though macroeconomic variables can explain momentum return better, however, the momentum return is not absolutely eliminated when accounted for these risk factors. Our results are strong during market expansions. Overall the results from Tables 4 through 7 implies that there is no evidence of absolute disappearance of momentum return after accounting for risk factors both at the portfolio level and at the individual stock level.

5. Discussion and conclusion

The overwhelming evidence documenting the persistence of momentum return presents a serious challenge to finance literature. Two explanations have largely been given by researchers to capture the phenomenon. While behavioural models support that there is momentum return and that idiosyncratic risk are crucial for such premium, risk-based

Table 8
Individual Stock Level Analysis: Momentum Return Based on Alternative Strategies At the Individual Stock Level Using Contemporaneous Fama–French and Macroeconomic Factors as risk factors: Ten-Year Sub-Period Results. The following table reports the monthly returns in percentage based on alternative momentum strategies. For each month *t*, the following model is estimated for each NYSE, AMEX and NASDAQ stock on the monthly CRSP database (using a sixty-month window and a minimum of 24 months of data required):$R_{it} = \alpha_i + \sum_{j=1}^{n} \beta_{ij} f_t + \varepsilon_{it}$, where, R_{it} is the return of each stock at time *t*, f_t is the vector of both Fama–French and Macroeconomic factors,β_{ij} is the factor loadings α_i and ε_{it} are constant and residual, respectively. Thereafter the model is decomposed into two components e.g. the stock specific components $(\widehat{\alpha}_i + \widehat{\varepsilon}_{it})$ and the risk factors $(\sum_{j=1}^{n} \widehat{\beta}_{ij} f_t)$. Stocks are ranked based on these two criterions using a formation period *J* of five months ($t-5$ *through* $t-1$) and deciles portfolios are formed with the lowest (P1) portfolio as the loser and highest portfolios (P10) as the winner portfolio. A long position in taken in the winner portfolio and short position in the loser portfolio and hold the position for the following *K* ($t+1$ *through* $t+6$) holding month. The momentum return is defined as the difference between the return on the winner and the loser portfolio. The returns exclude all penny stocks. Panel A reports the returns of loser, winner and momentum portfolio where stocks are ranked based on idiosyncratic factor, while Panel B reports the same while stocks are ranked based on risk factors. The column 'Decile portfolio size' reports the average size of the decile portfolio during each period. The column titled "% > 0"gives the percentage of Winner minus Loser that are positive. The last column reports the size of each sub-sample period. The estimates are reported in percentage, the number in bold fonts represent significance at the 5 percent level and t-statistics are also given.

Panel A: ranking based on idiosyncratic risk

Period		Loser	Winner	MR^{I}_{t*}	Decile portfolio size	% > 0	No. of months
1926–2005	Return	1.602	1.636	0.034	247	49.19%	895
	t-Stat	11.512	11.632	0.921			
1926–1935	Return	3.700	3.690	−0.010	64	20.00%	55
	t-Stat	4.181	4.109	−0.083			
1936–1945	Return	2.280	2.290	0.010	72	45.83%	120
	t-Stat	5.535	5.449	0.032			
1946–1955	Return	1.060	1.350	**0.290**	90	60.00%	120
	t-Stat	5.127	5.499	3.863			
1956–1965	Return	1.070	1.020	−0.050	108	52.50%	120
	t-Stat	5.451	5.596	−0.841			
1966–1975	Return	0.660	0.920	**0.260**	210	58.33%	120
	t-Stat	1.670	2.260	2.972			
1976–1985	Return	2.090	1.930	−0.160	416	45.83%	120
	t-Stat	7.748	6.310	−1.538			
1986–1995	Return	1.320	1.160	−0.160	488	42.50%	120
	t-Stat	4.503	4.550	−1.745			
1996–2005	Return	1.790	1.860	0.070	526	54.17%	120
	t-Stat	4.959	5.340	0.817			

Panel B: ranking based on risk factors

Period		Loser	Winner	$MR^{RiskFac}_{t*}$	Decile portfolio size	% > 0	No. of months
1926–2005	Return	1.617	1.632	0.015	302	47.23%	895
	t-Stat	11.366	11.431	0.352			
1926–1935	Return	3.570	3.780	0.210	71	25.00%	55
	t-Stat	4.066	4.174	0.905			
1936–1945	Return	2.340	2.260	−0.070	75	50.83%	120
	t-Stat	5.517	5.540	−0.484			
1946–1955	Return	1.330	1.100	**−0.230**	92	42.50%	120
	t-Stat	5.349	5.303	−3.022			
1956–1965	Return	1.000	1.080	0.080	114	47.50%	120
	t-Stat	5.411	5.468	1.297			
1966–1975	Return	0.890	0.640	**−0.240**	236	43.33%	120
	t-Stat	2.115	1.617	−2.597			
1976–1985	Return	1.880	2.110	**0.230**	494	55.83%	120
	t-Stat	6.036	7.472	2.019			
1986–1995	Return	1.130	1.420	**0.290**	626	60.83%	120
	t-Stat	4.341	4.701	2.796			
1996–2005	Return	1.880	1.840	−0.040	709	45.83%	120
	t-Stat	4.970	4.600	−0.431			

explanation claims that risk factors explain momentum returns and there is no momentum return after adjusting for such risk components. Nevertheless, the debate is yet to settle on whether or not there is momentum return after adjusting for risk factors particularly at different level of analysis e.g. at the portfolio level and at individual stock level.

In this paper, we examine whether momentum returns remain after accounting for risk factors by using a dynamic framework of the level of analysis. Theoretically if momentum return is a compensation for risk as argued by rationalists, then momentum return should disappear once priced for those risk factors. Our results provide evidence to contradict this hypothesis. By looking into the alpha of the regression at the portfolio level we show that momentum return remains after adjusting for risk factors. We report positive and significant alpha of 0.009 during the full sample period and in different sub-periods when Fama–French three factors are used as contemporaneous risk factors. We confirm that even when lagged variables are employed momentum return remains unexplained by Fama–French three factors. Also in contrast to the findings of earlier literature that report that momentum return can be explained by macroeconomic variables we report significant positive alpha once priced for these variables at the portfolio level. We show empirically that regardless of whether the variable is contemporaneous or lagged alpha is positive and significantly different from zero. For instance, for contemporaneous macroeconomic variables during the full sample period alpha is 0.015 and 0.009 in different sub-periods and for lagged variable alpha is 0.009 in the entire sample period and on average 0.014 in different sub-periods all of which are statistically significant. Our above evidences strongly rejects the argument that momentum return can be explained. We conclude that momentum return remains after adjusting for known risk factors at the portfolio level, be it contemporaneous or lagged variables or be it micro or macro variables.

Secondly, we employ an alternative momentum strategy at the individual stock level and show that even at the stock level risk factors cannot absolutely eliminate momentum return. We generate momentum return based on alternative strategies e.g. conditioned on the risk factors and the idiosyncratic risk. This is because if momentum return can be explained by risk factors then there should not be any momentum return generating from idiosyncratic components once risk factors are adjusted for. By observing the momentum return generated from each alternative strategy we evaluate whether or not risk factors can explain momentum return at the individual stock level. We provide evidence that when Fama–French three factors are

Table 9

Individual Stock Level Analysis: Momentum Return Based on Alternative Strategies At the Individual Stock Level Using Lagged Fama–French and Macroeconomic Factors as risk factors: Ten-Year Sub-Period Results. The following table reports the monthly returns in percentage based on alternative momentum strategies. For each month t, the following model is estimated for each NYSE, AMEX and NASDAQ stock on the monthly CRSP database (using a sixty-month window and a minimum of 24 months of data required): $R_{it} = \alpha_i + \sum_{j=1}^{n} \beta_{ij} f_{t-1} + \varepsilon_{it}$, where, R_{it} is the return of each stock at time t, f_{t-1} is the vector of both Fama–French and macroeconomic factors, β_{ij} is the factor loadings α_i and ε_{it} are constant and residual, respectively. Thereafter the model is decomposed into two components e.g. the stock specific components $(\widehat{\alpha}_i + \widehat{\varepsilon}_{it})$ and the risk factors $(\sum_{j=1}^{n} \widehat{\beta}_{ij} f_{t-1})$. Stocks are ranked based on these two criterions using a formation period J of five months ($t-5$ *through* $t-1$) and deciles portfolios are formed with the lowest (P1) portfolio as the loser and highest portfolios (P10) as the winner portfolio. A long position in taken in the winner portfolio and short position in the loser portfolio and hold the position for the following K ($t+1$ *through* $t+6$) holding month. The momentum return is defined as the difference between the return on the winner and the loser portfolio. The returns exclude all penny stocks. Panel A reports the returns of loser, winner and momentum portfolio where stocks are ranked based on idiosyncratic factor, while Panel B reports the same while stocks are ranked based on risk factors. The column 'Decile portfolio size' reports the average size of the decile portfolio during each period. The column titled "$\% > 0$"gives the percentage of Winner minus Loser that are positive. The last column reports the size of each sub-sample period. The estimates are reported in percentage, the number in bold fonts represent significance at the 5 percent level and t-statistics are also given.

Panel A: Ranking based on idiosyncratic risk								Panel B: Ranking based on risk factors							
Period		Loser	Winner	MR^{I}_{t*}	Decile portfolio size	$\% > 0$	No. of months	Period		Loser	Winner	$MR^{RiskFac}_{t*}$	Decile portfolio size	$\% > 0$	No. of months
1926–2005	Return	1.652	1.567	−0.085	247	52.13%	895	1926–2005	Return	1.525	1.695	**0.169**	302	46.30%	895
	t-Stat	11.188	12.080	−1.519					t-Stat	11.525	11.063	2.841			
1926–1935	Return	3.69	4.28	**0.59**	64	30.83%	55	1926–1935	Return	4.23	3.96	−0.270	71	15.83%	55
	t-Stat	3.91	5.22	2.33					t-Stat	5.106	4.097	−0.884			
1936–1945	Return	2.99	1.44	**−1.55**	72	25.00%	120	1936–1945	Return	1.4	2.97	**1.570**	75	72.50%	120
	t-Stat	6.14	4.56	−6.82					t-Stat	4.532	6.054	6.506			
1946–1955	Return	1.00	1.33	**0.33**	90	64.17%	120	1946–1955	Return	1.29	1.02	**−0.270**	92	38.33%	120
	t-Stat	4.26	6.09	3.52					t-Stat	5.914	4.332	−2.937			
1956–1965	Return	0.99	1.03	0.04	108	50.00%	120	1956–1965	Return	0.97	1.01	0.040	114	53.33%	120
	t-Stat	5.78	5.05	0.33					t-Stat	4.722	5.883	0.344			
1966–1975	Return	0.63	0.83	**0.20**	210	60.83%	120	1966–1975	Return	0.73	0.73	−0.010	236	49.17%	120
	t-Stat	1.59	2.08	2.07					t-Stat	1.791	1.799	−0.106			
1976–1985	Return	2.15	1.84	**−0.31**	416	44.17%	120	1976–1985	Return	1.82	2.09	**0.270**	494	52.50%	120
	t-Stat	7.78	6.48	−3.08					t-Stat	6.290	6.676	2.342			
1986–1995	Return	1.28	1.23	−0.06	488	54.17%	120	1986–1995	Return	1.19	1.35	0.160	626	51.67%	120
	t-Stat	4.16	5.10	−0.44					t-Stat	4.727	4.269	1.167			
1996–2005	Return	1.62	2.08	**0.46**	526	67.50%	120	1996–2005	Return	2.07	1.68	**−0.390**	709	36.67%	120
	t-Stat	4.498	6.001	4.039					t-Stat	5.587	4.159	−3.147			

considered, idiosyncratic risk produce 0.45 percent while when the lagged variables are used the payoff generated is 0.43 percent. This implies that momentum return remains once adjusted for Fama–French factors at the individual stock level.

When macroeconomic variables are considered we report an opposite pattern. Most of the momentum return is generated from stocks when sorted based on macroeconomic variables and are statistically significant. Interestingly, the resulting of momentum after adjustments for macroeconomic variables are more pronounced during market upturn. For instance, during the two end of the sample period when US market experience market downturn e.g. market crisis in 1929 several market crashes after 2000s, macroeconomic variables cannot explain momentum payoff. On the other hand during the mid-sample period, particularly during the period used in the study of Chordia and Shivakumar (2002) e.g. from 1953 through 1994 most momentum payoff generates from macroeconomic variable. The result is more significant when lagged variables are used. Chordia and Shivakumar (2002) report that macroeconomic variable can explain momentum return. We report that macroeconomic variables can only partially explain momentum return and is distinct during market upturns. Not surprisingly, when we combine both Fama–French factors and macroeconomic factors the result is mixed. This could be attributed to the inverse effect of Fama–French three factors and macroeconomic factors in explaining momentum return, particularly during market upturn.

Our empirical results have important implication in designing momentum strategy particularly for investors who hold portfolios based on the market premium, size and book-to-market or based on the macroeconomic variables. At each phase of the business cycle our findings will provide important insight as to whether or not the investors can gain momentum return from the portfolio they hold. Of course our time series analysis holds as long as Fama–French three factors and macroeconomic factors are the only risk factors considered. Further studies incorporating more risk factors and evaluating the relative magnitude of the micro and macro variables would sharpen our understanding about the interaction between momentum return and risk factors.

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